FORT POLK AIRFIELD HANGAR

LIGHTING

LIGHTING RETROFIT

Fort Polk, Louisiana

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

March, 1993

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FORT POLK, LA

OVERALL SAVINGS

AIRFIELD HI-BAY LIGHTING

	MBTU	$	SIR
B/4262 Hi-Bay	249	709	0.34
Support	184	1,114	0.34
B/4295 Hi-Bay	276	791	0.34
Support	191	1,073	0.26
B/4297 Hi-Bay	72	(735)	-0.17
Support	51	336	0.17
TOTAL	1,023	3,288	
CHILLER FREE COOLING			
	160	2,541	0.99
OVERALL	1,183	5.829	

No SIRs >1

FY 92

LIMITED

ENERGY

STUDY

FORT POLK, LA

LIGHTING

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP) for FORT POLK AIRFIELD HANGAR LIGHTING

Fort Polk, Louisiana

I. NARRATIVE

A. Purpose

The purpose of this study is to analyze the existing lighting types and levels at three different maintenance hangars (Buildings. No. 4262, No. 4295, and No. 4297) at Fort Polk and to make recommendations for the most economical and preferred new lighting fixtures, arrangements, and method of control.

This report is prepared in accordance with the general and detailed scope of work for Contract No. DACA63-91-D-0048, Delivery Order 0004 (Refer to Appendix G for complete scope of work). The Life Cycle Cost In Design (LCCID) program was used to determine the Life Cycle Cost (LCC) and Savings to Investment Ratio (SIR) for the analyzed retrofit for a 20 year study life.

B. Facility Description

1. Maintenance hangar Building No. 4262

Area	Square Feet
Hangar	12,388
Support	17,481

This facility is the smallest and oldest of the three hangars and consists of a 2 bay hangar and a two story support area which includes multiple shop areas, general office space, and storage areas.

2. Maintenance hangar Building No. 4295

Area	Square Feet
Hangar	19,683
Support	26,341

This facility consists of a 4 bay hangar and a two story support area which includes multiple shop areas, general office space, and storage areas.

3. Maintenance hangar Building No. 4297

Area	Square Feet
Hangar	27,520
Support	20,124

This facility is the largest of the three hangars and consists of a 4 bay hangar and a two story support area which includes multiple shop areas, general office space, and storage areas.

C. Design Criteria

The following average maintained illumination levels, taken from Table C-4 of the Corps of Engineers Standard Detail No. 40-06-04, dated February, 1991 and from the IES Lighting Handbook, were used for this analysis:

Functional Areas	Footcandles
Hangar	75
Offices	50
Corridors	10
Shops	50-75
Toilets/Lockers	20

D. Analysis

1. Existing Lighting

The following is a general description of the existing lighting fixture locations and types. For a detailed description of the existing fixtures refer to Appendix F. Quantities of existing fixtures are indicated in Appendix A. The existing footcandle levels which were measured by Fort Polk personnel in March 1992 are included in Appendix B.

a. Building No. 4262

(1) Fixture Types A and A2

Fixture type A is installed in the hangar and is placed in three rows twenty-four feet on center. Each row has eight fixtures placed twenty feet on center. Four of the twenty-four fixtures are equipped with a quartz restrike system. Footcandle measurements taken by Fort Polk personnel show the existing lighting level to be inadequate in comparison to the required lighting level of 75 footcandles. This fixture uses a 1000W mercury vapor lamp and consumes 1075 watts.

(2) Fixture Type B

Fixture type B is installed on the first floor in some of the shop rooms, in the toilets and corridors, and the breakroom. This fixture uses 2-F40T12/RS lamps with a magnetic ballast and consumes 96 watts.

(3) Fixture Type C

Fixture type C is installed on the second floor in the offices and classroom. This fixture uses 2-F40T12/RS lamps with a magnetic ballast and consumes 96 watts.

(4) Fixture Type D

Fixture type D is installed in the small parts shop on the first floor. This fixture uses 2-F40T12/RS lamps with a magnetic ballast and consumes 96 watts.

(5) Fixture Type E

Fixture type E is installed in the toilets and showers on the second floor. This fixture uses 2-F40T12/RS lamps with a magnetic ballast and consumes 96 watts.

(6) Fixture Type F

Fixture type F is installed in the mechanical equipment room, uses an incandescent lamp, and consumes 300 watts.

(7) Fixture Type H

Fixture type H is installed in the battery storage room, uses an incandescent lamp, and consumes 300 watts.

(8) Fixture Type K

Fixture type K is installed above the exterior doors, uses an incandescent lamp, and consumes 200 watts.

(9) Fixture Type L

Fixture type L is installed in the hangar area, uses an incandescent lamp, and consumes 75 watts.

(10) Fixture Type M

Fixture type M is installed on the exterior of the building, uses a 1000W high pressure sodium lamp and consumes 1100 watts. This fixture is currently controlled by a photocell.

(11) Fixture Type P

Fixture type P is installed on the second floor in the toilets and showers. This fixture use 2-F40CW/RS lamps with a magnetic ballast and consumes 96 watts.

(12) Fixture Type R

Fixture type R is installed in the janitors closet and uses two incandescent lamps and consumes 80 watts.

(13) Fixture Type S

Fixture type S is installed in the stairwells and a corridor. This fixture uses 1-F40T12/RS lamp with a magnetic ballast and consumes 56 watts.

(14) Fixture Type T

Fixture type T is installed in the paint shop, uses an incandescent lamp, and consumes 500 watts.

(15) Fixture Type V

Fixture type V is installed in the stairwells. This fixture uses 1-F40T12/RS lamp with a magnetic ballast and consumes 56 watts.

(16) Fixture Type W

Fixture type W is installed in the avionics shop and the armaments shop. This fixture uses 3-F40T12/RS lamps with magnetic ballasts and consumes 152 watts.

(17) Fixture Types X and X2

Fixture types X and X2 are installed throughout the facility and use two incandescent lamps each. Each fixture consumes 40 watts.

(18) Fixture Types E1 and E2

Fixture types E1 and E2 are installed throughout the facility and use two incandescent lamps each. Each fixture consumes 56 watts.

b. Building No. 4295

(1) Fixture Types A and B

Fixture types A and B are installed in the hangar and are placed in five rows sixteen feet on center. Each row has fourteen fixtures seventeen feet on center. Six of the seventy fixtures are equipped with a quartz restrike system. These fixtures are mounted twenty-nine feet above the finished floor. The lighting levels in this

hangar were measured by Fort Polk personnel and were found to be inadequate per the requirements of 75 footcandles. This fixture uses a 400W metal halide lamp and consumes 460 watts.

(2) Fixture Type C

Fixture type C is installed on the first floor in many of the storage and shop rooms. This fixture uses 2-F40T12/RS lamps with a magnetic ballast and consumes 96 watts.

(3) Fixture Type D

Fixture type D is installed in the paint shops and the drive-thrus on the first floor and in the corridors and stairwells on the second floor. This fixture uses 2-F40T12/RS lamps with a magnetic ballast and consumes 96 watts.

(4) Fixture Types E and F

Fixture types E and F are installed in the first floor office areas. These fixtures use 2-F40CW/RS lamps with a magnetic ballast. These fixtures consume 96 watts each.

(5) Fixture Type G

Fixture type G is installed in a stairwell and uses 2-F40CW/RS lamps with a magnetic ballast. This fixture consumes 96 watts.

(6) Fixture Type H

Fixture type H is installed in the rest rooms and showers. This fixture uses 2-F40T12/RS lamps with a magnetic ballast and consumes 96 watts.

(7) Fixture Type J

Fixture type J is installed on the exterior of the building and uses a 1000W high pressure sodium lamp. This fixture consumes 1100 watts and is currently controlled by a photocell.

(8) Fixture Type K

Fixture type K is installed on the second floor in the offices. This fixture uses 2-F40T12/RS lamps with a magnetic ballast and consumes 96 watts.

(9) Fixture Type L

Fixture type L is installed in the toilet and showers. This fixture uses an incandescent lamp and consumes 100 watts.

(10) Fixture Type M

Fixture type M is installed in the toilets and showers and uses 1-F40T12/RS lamp with a magnetic ballast. This fixture consumes 56 watts.

(11) Fixture Type P

Fixture type P is installed in the mechanical room and uses an incandescent lamp. This fixture consumes 150 watts.

(12) Fixture Type R

Fixture type R is installed on the exterior of the building and uses a 400W high pressure sodium lamp. This fixture consumes 460 watts and is currently controlled by a photocell.

(13) Fixture Types X1 and X2

Fixture types X1 and X2 are installed throughout the building and use two incandescent lamps each and consume 40 watts each.

(14) Fixture Types E1 and E2

Fixture types E1 and E2 are installed throughout the building and use two incandescent lamps. This fixture consumes 56 watts.

c. Building No. 4297

(1) Fixture Types A and B

Fixture types A and B are installed in the hangar and placed in three rows twenty-five feet on center. Each row has eight fixtures placed forty feet on center. Five of the fixtures are equipped with a quartz restrike system. Footcandle measurements taken by Fort Polk personnel show the existing lighting level to be inadequate in comparison to the required lighting level of 75 footcandles. This fixture uses a 1000W high pressure sodium lamp and consumes 1100 watts.

(2) Fixture Type C

Fixture type C is installed in the offices and uses 4-F40T12/RS/ES lamps with energy saving ballasts and consumes 144 watts.

(3) Fixture Type D

Fixture type D is installed in the offices and uses 2-F40T12/RS/ES lamps with an energy saving ballast and consumes 72 watts.

(4) Fixture Type E

Fixture type E is installed in storage rooms, the electrical and mechanical rooms, the supply and parts rooms, the drive-thru and various shop rooms. This fixture uses 2-F40T12/RS/ES lamps with an energy saving ballast and consumes 72 watts.

(5) Fixture Type F

Fixture type F is installed in the mechanical/electrical room. This fixture uses 2-F40T12/RS/ES lamps with an energy saving ballast and consumes 72 watts.

(6) Fixture Type G

Fixture type G is used throughout the facility and uses two incandescent lamps. This fixture consumes 40 watts.

(7) Fixture Type H

Fixture type H is used in the janitors room and uses one incandescent lamp and consumes 60 watts.

(8) Fixture Type J

Fixture type J is used on the exterior of the building and uses a 250W high pressure sodium lamp. This fixture consumes 305 watts.

(9) Fixture Type L

Fixture type L is installed in the showers, battery storage, and the vaults. This fixture uses 2-F40T12/RS/ES lamps with an energy saving ballast and consumes 72 watts.

(10) Fixture Type M

Fixture type M is installed in the stairwells and uses 2-F40T12/RS/ES lamps and an energy saving ballast and consumes 72 watts.

(11) Fixture Type N

Fixture type N is installed in the office areas and uses 3-F40T12/RS/ES lamps and an energy saving ballast and consumes 120 watts.

(12) Fixture Type U

Fixture type U is installed throughout the facility and uses two incandescent lamps. This fixture consumes 20 watts.

(13) Fixture Type X

Fixture type X is mounted on the exterior of the building and uses two incandescent lamps. This fixture consumes 200 watts.

(14) Fixture Type Y

Fixture type Y is installed in the women's and men's locker rooms, the corridors and the breakroom. This fixture uses 2-F40T12/RS/ES lamps with an energy saving ballast and consumes 72 watts.

2. Proposed Retrofit Lighting

a. Building No. 4262

(1) Fixture Types A and A2

The proposed replacement for fixture types A and A2 is a high level/low level HID lighting system (similar to Day-Brite's Hi/Lo System). This system will provide the required footcandle level of 75 footcandles when at the high level and will drop to approximately 20% of the fixtures rated full lumen output and 40% of the fixture's input watts when on the low level.

The existing three rows of fixtures will be replaced with two rows of 1000W metal halide high bay fixtures located in the same locations as the existing fixtures two outer rows. This layout will achieve the required 75 footcandles at the high level when the floor, walls and ceiling are painted white creating reflectances of 50%, 50%, and 70% respectively. These fixtures will be connected to existing circuits. The lighting control will be provided by a photocell located in the rear of every zone. There will be four zones having four fixtures each. When the photocell detects a high ambient light source, the fixtures will drop to the low level. A manual override switch will be provided at every zone to turn the fixtures up to the high level or to return to the photocell controlled mode. This fixture will consume 1080 watts when at full lumen output and 432 watts when at low lumen output.

(2) Fixture Types B, C, D, E and P

The proposed retrofit for these fixtures is to replace the F40T12/RS lamps and magnetic ballasts with F40T12/RS/SS lamps and electronic ballasts (similar to a

Valmont Opti-Miser ballast). This would reduce the fixture wattage from 96 watts to 58 watts.

(3) Fixture Type F

The proposed replacement for fixture type F is a 2-lamp, 4-foot, fluorescent industrial fixture (similar to Day-Brite's Industrial FL series fixtures). It will use 2-F40T12/RS/SS lamps with an electronic ballast and will be chain hung. This fixture will replace a 300W incandescent fixture and will consume only 58 watts.

(4) Fixture Type H

The proposed replacement for fixture type H is an enclosed and gasketed 2-lamp, 4 foot, pendant mounted fluorescent fixture (similar to Day-Brite's Dust-Tite protected fluorescent). This fixture will use 2-F40T12/RS/SS lamps with an electronic ballast and will consume 58 watts versus 300 watts with the existing incandescent fixture.

(5) Fixture Type K

The proposed replacement for fixture type K is a heavy-duty, gasketed, HID wall pack controlled by a photocell. (Similar to Day-Brite's Wall Light). This fixture will house a 100 watt high pressure sodium lamp and will consume 115 watts versus 200 watts with the existing incandescent fixture.

(6) Fixture Type L

Fixture type L is not considered for retrofit due to the minimal quantities and prohibitive retrofit costs.

(7) Fixture Type M

The proposed replacement for fixture type M to achieve glare free lighting is a sharp cut off HID shoe box style fixture (similar to Emco's Infinisquare fixture). The existing fixtures are floodlights which are aimed vertically causing an excess of vertical illumination and glare. The new cut off fixtures are aimed horizontally providing good horizontal illumination but little glare.

This fixture will use a 1000W metal halide lamp and will consume 1050 watts and will be photocell controlled. The existing circuits rated for 1000 watt high pressure sodium floodlights will be reused for these new sharp cut-off metal halide luminaries.

(8) Fixture Type R

Fixture type R is not considered for retrofit due to the minimal quantities and prohibitive retrofit costs.

(9) Fixture Type S

The proposed retrofit for fixture type S is to replace the F40T12/RS lamp and magnetic ballast with a F40T12/RS/SS lamp and an electronic ballast. This retrofit will reduce the fixture wattage from 56 watts to 29 watts.

(10) Fixture Type T

The proposed replacement for fixture type T is an enclosed and gasketed, 2-lamp, 4 foot, fluorescent fixture (similar to Day-Brite's Dust-Tite protected fluorescent). This fixture will use 2-F40T12/RS/SS lamps with an electronic ballast and will consume 58 watts versus 500W with the existing incandescent fixtures.

(11) Fixture Type V

The proposed retrofit for fixture type V is to replace the existing F40T12/RS lamp and magnetic ballast with a F40T12/RS/SS lamp and an electronic ballast. This fixture will consume 29 watts versus 56 watts with the existing lamp and ballast.

(12) Fixture Type W

The proposed retrofit for fixture type W is to replace the existing F40T12/RS lamps and magnetic ballast with F40T12/RS/SS lamps and an electronic ballast. This fixture will consume 88 watts versus 152 watts with the existing lamps and ballast.

(13) Fixture Types X and X2

The proposed replacement for fixture types X and X2 is an exit light (similar to Lithonia's Titan Series) with 1-F7TT lamp. This fixture would consume 9 watts versus 40 watts with the existing incandescent fixtures. The existing exit signs are equipped with 2-15T6 incandescent lamps which have a candelabra base. Currently, there is not an exit sign efficiency conversion kit for this type of incandescent base.

(14) Fixture Types E1 and E2

Fixture types E1 and E2 are not considered for retrofit due to minimal use of these fixtures.

b. Building No. 4295

(1) Fixture Types A and B

The proposed replacements for fixture types A and B is a high level/low level HID lighting system (similar to Day-Brite's Hi/Lo System). This system will provide the required footcandle level of 75 footcandles when at the high level lumen output and will drop to approximately 20% of the fixture's rated full lumen output and 40% of the fixture's input watts when on the low level.

All five rows of existing fixtures will be completely removed. All branch circuits and control switching pertaining to these rows will be abandoned. The new 1000W Metal Halide high bay fixtures will be placed in three rows spaced thirty-one feet apart. Each row will have eight fixtures thirty feet on center. This layout will achieve the required 75 footcandles when the floor, walls, and ceiling are painted white creating reflectances of 50%, 50%, and 70% respectively. These fixtures will be recircuited with two fixtures per circuit and the circuit running from the front of the hangar to the rear of the hangar not from side to side as they are currently circuited. The lighting control will be provided by a photocell located in the rear of every zone. There will be four zones having six fixtures each. When the photocell detects a high ambient light source the fixtures will drop to the low light level. A manual override

switch will be provided at every zone to turn the fixtures up to the high level or to return to the photocell controlled mode. This fixture will consume 1080 watts when at full lumen output and 432 watts when at low lumen output.

(2) Fixture Types C, D, E, F, G, H and K

The proposed retrofit for these fixtures is to replace the existing F40T12/RS lamps and magnetic ballasts with F40T12/RS/SS lamps and electronic ballasts (similar to Valmont's Opti-Miser). These fixtures will consume 58 watts versus 96 watts for the existing lamps and ballasts.

(3) Fixture Type J

The proposed replacement for fixture type J to achieve glare free lighting is a sharp cut-off HID shoe box style fixture (similar to Emco's Infinisquare fixture). The existing fixtures are floodlights which are aimed vertically causing an excess of vertical illumination and glare. The new cut off fixtures are aimed horizontally providing good horizontal illumination but little glare. This fixture will use a 1000W metal halide lamp and will consume 1050 watts and will be photocell controlled. The existing circuits rated for 1000 watt high pressure sodium floodlights will be reused for these new sharp cut-off metal halide luminaries.

(4) Fixture Type L

Fixture type L is not considered for retrofit due to minimal quantities and use.

(5) Fixture Type M

The proposed retrofit for fixture type M is to replace the existing F40T12/RS lamps and magnetic ballasts with F40T12/RS/SS lamps and electronic ballasts. This fixture will consume 29 watts versus 56 watts with the existing lamps and ballasts.

(6) Fixture Type P

The proposed replacement for fixture type P is a 2-lamp, 4 foot, fluorescent industrial fixture (similar to Day-Brite's Industrial FL series fixtures). This fixture will be pendant mounted or chain hung and will use F40T12/RS/SS lamps with an electronic ballast. This fixture will consume 58 watts versus 150 watts with the existing incandescent fixtures.

(7) Fixture Type R

The proposed replacement for fixture type R to achieve glare free lighting is a sharp cut-off HID shoe box style fixture (similar to Emco's Infinisquare fixture). The existing fixtures are floodlights which are aimed vertically causing an excess of vertical illumination and glare. The new cut off fixtures are aimed horizontally providing good horizontal illumination but little glare. This fixture will use a 400W metal halide lamp and will consume 460 watts and will be photocell controlled. The existing circuits rated for 400 watt high pressure sodium floodlights will be reused for these new sharp cut-off metal halide luminaries.

(8) Fixture Type X1 and X2

The proposed retrofit for fixtures type X1 and X2 is an exit sign (similar to Lithonia's Titan Series) with one F7TT lamp. This fixture will consume 9 watts versus 40 watts with the existing fixtures. The existing exit signs are equipped with 2-15T6 incandescent lamps which have a candelabra base. Currently, there is not an exit sign efficiency conversion kit for this type of incandescent base.

(9) Fixture Types E1 and E2

Fixture types E1 and E2 are not considered for retrofit due to minimal use of these fixtures.

c. Building No. 4297

(1) Fixture Types A and B

The proposed replacements for fixtures type A and B is a high level/low level HID lighting system (similar to Day-Brite's Hi/Lo Systems). This system will provide the required footcandle level of 75 footcandles when at the high level and will drop to approximately 20% of the fixture's rated full lumen output and 40% of the fixture's input watts.

The existing fixtures will be replaced with 1000 watt metal halide high bay fixtures in the same locations as existing fixtures and will be reconnected to existing circuits. New fixture columns (three fixtures per column) will be added in between existing fixture columns with a total of 21 new fixtures and will require seven new circuits. This new fixture layout will provide the required 75 footcandles when the fixtures are controlled on the high level and the floor, walls, and ceiling are painted white creating reflectances of 50%, 50%, and 70% respectively. The lighting control will be provided by a photocell located in the rear of every zone. There will be eight zones. When the photocell detects a high ambient light source, the fixtures will drop to the low level. A manual override switch will be provided at every zone to turn the fixtures up to the high level or to return to the photocell controlled mode. This fixture will consume 1080 watts when at full lumen output and 432 watts when at low lumen output.

(2) Fixture Type C

The proposed retrofit for fixture type C is to replace the existing energy saving ballasts with electronic ballasts (similar to Valmont's Opti-Miser). This fixture will consume 116 watts versus 144 watts with the existing ballasts.

(3) Fixture Types D, E, F, L, M, Y

The proposed retrofit for these fixtures is to replace the existing energy saving ballasts with electronic ballasts. This fixture will consume 58 watts versus 72 watts with the existing ballasts.

(4) Fixture Type G

The proposed replacement for fixture type G is an exit sign conversion kit that will replace the two 20T6 incandescent lamps with one F9TT fluorescent lamp which will accommodate the existing D.C. Bayonet lamp base. This fixture will consume 9 watts versus 40 watts with the existing incandescent fixtures.

(5) Fixture Type H

Fixture type H is not considered for retrofit due to minimal quantities and use of this fixture.

(6) Fixture Type J

The proposed replacement for fixture J to achieve glare free lighting is a sharp cut-off HID shoe box style fixture (similar to Emco's Infinisquare fixture). The existing fixtures are floodlights which are aimed vertically causing an excess of vertical illumination and glare. The new cut off fixtures are aimed horizontally providing good horizontal illumination but little glare. This fixture will use a 1000W metal halide lamp and will consume 1050 watts and will be controlled by a photocell. There are four existing fixtures which will be removed. There will be three new fixtures spaced evenly apart across the front of the hangar. These fixtures will have to be recircuited.

(7) Fixture Type N

The proposed retrofit for fixture type N is to replace the existing energy saving ballasts with an electronic ballast. This fixture will consume 88 watts versus 105 watts with the existing ballasts.

(8) Fixture Type X

Fixture type X is not considered for retrofit due to minimal quantities.

(9) Fixture Type U

Fixture type U is not considered for retrofit due to minimal use of these fixtures.

E. Methodology

1. Sample calculations of the illumination levels for the retrofit fixtures were calculated using the zonal cavity approach to ensure that they meet or exceed the requirements of the Corps of Engineers Standard Detail No. 40-06-04 and the IES Lighting Handbook. These calculations are included in Appendix B.

2. The energy savings calculations for the retrofit fixtures were calculated using the following sample method and are listed in Appendix A.

$$\textit{Total Number of Fixtures} = 300$$

$$\textit{Savings per Fixture} = 96 - 58 = 38 \textit{ watts}$$

$$\textit{KW Savings} - 300 \textit{ Fixtures} \times \frac{38 \textit{ Watts}}{\textit{Fixture}} \times \frac{1 \textit{ KW}}{1{,}000 \textit{ Watts}} - 11.4 \textit{ KW}$$

$$\textit{Annual KW Savings} = 11.4 \textit{ KW} \times \$3.00/\textit{KW} \times 12 \textit{ mos/yr} = \$410.00/\textit{yr}$$

$$\textit{KWH Savings} = 11.4 \textit{ KW} \times 10 \textit{ hrs/day} \times 6 \textit{ days/week} \times 50 \textit{ weeks/yr} = 34{,}200 \textit{ KWH}$$

$$\textit{Annual KWH Savings} = 34{,}200 \textit{ KWH/yr} \times \$0.00249/\textit{KWH} = \$85.16/\textit{yr}$$

3. The life cycle economic feasibility was calculated using the Blast, Life Cycle Cost in Design (LCCID) program using the energy consumption calculated and included in Appendix E. Data sources for the LCCID feasibility study are as follows:

   a. Construction Cost Estimate

      The probable additional construction cost estimates for the airfield hangar lighting is as follows:

	Additional Investment
Hangar and Exterior Retrofit Lighting Bldg. 4262	$21,867
Support Area Retrofit Lighting Bldg. 4262	$33,732
Hangar and Exterior Retrofit Lighting Bldg. 4295	$24,569
Support Area Retrofit Lighting Bldg. 4295	$42,013
Hangar and Exterior Retrofit Lighting Bldg. 4297	$39,934
Support Area Retrofit Lighting Bldg. 4297	$21,310

Refer to Appendix C for the probable cost estimate.

b. Replacement/Maintenance Cost Difference Estimate

Hangar & Exterior Retrofit Lighting Bldg. 4262	$243/year*
Support Area Retrofit Lighting Bldg. 4262	$342/year*
Hangar & Exterior Retrofit lighting Bldg. 4295	$475/year*
Support Area Retrofit Lighting Bldg. 4295	$479/year*
Hangar & Exterior Retrofit Lighting Bldg. 4297	$591/year*
Support Area Retrofit Lighting Bldg. 4297	$358/year*
* *Begins after retrofit is in operation for 5 years due to all new lamps and ballasts.*	

See Appendix D for calculations.

c. Final Salvage Value

The final salvage value for the three buildings is assumed to be $0.00.

d. Utility Rates

Utility Type	Electricity	
Demand	$3.00/KW	---
Usage	$.00249/KWH	$.730/MBTU

The energy cost was furnished by Louisiana Power & Light Company and is extracted from the large general service rate schedule.

e. Tabular Summary (in March 1993 Present Dollars)

Description	Bldg. 4262		Bldg. 4295		Bldg. 4297	
	Hangar & Exterior Retrofit Lighting	Support Area Retrofit Lighting	Hangar & Exterior Retrofit Lighting	Support Area Retrofit Lighting	Hangar & Exterior Retrofit Lighting	Support Area Retrofit Lighting
Total Demand Saved (KW)*	10	22	6	23	(24)	6
Total Usage Saved (KWH)*	73,000	54,000	81,000	56,000	21,000	15,000
LCC Initial Cost ($)	$24,382	$37,611	$27,394	$46,844	$44,526	$23,761
LCC Replacement Cost ($)	($2,145)	($2,252)	($4,353)	($1,727)	($1,346)	($1,256)
LCC Energy Cost ($)	($6,031)	($10,477)	($4,929)	($10,648)	$9,056	($2,773)
Total LCC Costs ($)	$16,206	$24,882	$18,112	$34,469	$52,236	$19,732
Net LCC Savings ($)	$8,177	$12,729	$9,282	$12,375	($7,709)	$4,030
Savings to Investment Ratio (SIR)	0.34	0.34	0.34	0.26	(0.17)	0.17

** Refer to Appendix A for calculations.*

F. Executive Summary

The recommended retrofit for maintenance hangars buildings 4262, 4295, and 4297 is to replace existing fluorescent fixtures with energy saving fluorescent lamps and electronic ballasts. The recommended retrofit for the hangar bays is to provide a well distributed light at the required footcandle levels as well as provide a versatile and energy saving method of control. This will be achieved by incorporating energy efficient lamps and fixtures in a more reflective environment with a high/low level of control. Skylights which are a variable factor in lighting design are not recommended due to the fact that

natural daylight is not always dependable. Also because of the size of these facilities, installing and maintaining these skylights would be too expensive for a retrofit situation. This recommendation does not provide a savings to investment ratio (SIR) greater than one (1) on any of the three buildings. This is mainly due to the fact that the existing footcandle levels in all three maintenance hangars are inadequate and will require new fixtures with greater wattages to increase the light level.

G. References

1. Corps of Engineers Standard Detail No. 40-06-04
   February, 1991

2. OCE - AEI
   Design Criteria
   December 9, 1991

3. TM5-802-1
   Economic Studies for Military Construction
   Design - Applications
   December, 1986

4. ANSI C82.2-84
   Fluorescent Lamp Ballasts -
   Methods of Measurement

5. IES-Lighting Handbook
   Applications and Reference Volumes

APPENDIX E - Life Cycle Cost Calculation

Building 4262

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT POLK REGION NO. 3 PROJECT NO.
PROJECT TITLE: FT POLK AIRFIELD HANGAR LIGHTING EEAP FISCAL YEAR 95
DISCRETE PORTION NAME: LIGHTING RETROFIT BUILDING 4262 HANGAR AND EXTERIOR LIGHTING
ANALYSIS DATE: 17-Mar-93 ECONOMIC LIFE 15 PREPARER ECD

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$21,867		
B. SIOH	$1,203		
C. DESIGN COST	$1,312		
D. TOTAL COST (1A+1B+1C)	$24,382		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$0	
F. PUBLIC UTILITY COMPANY REBATE		$0	
G. TOTAL INVESTMENT (1D-1E-1F)			$24,382

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: OCTOBER 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$0.73	249	$182	11.77	$2,139
B. DIST			$0		$0
C. RESID			$0		$0
D. NG			$0		$0
E. PPG			$0		$0
F. COAL			$0		$0
G. SOLAR			$0		$0
H. GEOTH			$0		$0
I. BIOMA			$0		$0
J. REFUS			$0		$0
K. WIND			$0		$0
L. OTHER			$0		$0
M. DEMAND SAVINGS			$350	11.12	$3,892
N. TOTAL			$532		$6,031

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	$0		
(1) DISCOUNT FACTOR (TABLE A)		-	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$0

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

B. NON RECURRING SAVINGS (+) OR COST(−)

	ITEM	SAVINGS(+) COST(−)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(−)(4)
a	RELAMPING	$339	1	0.96	$325
b	RELAMPING	$339	2	0.92	$312
c	RELAMPING	$339	3	0.89	$302
d	RELAMPING	$339	4	0.85	$288
e	RELAMPING	$339	5	0.82	$278
f	RELAMPING	$96	6	0.79	$76
g	RELAMPING	$96	7	0.76	$73
h	RELAMPING	$96	8	0.73	$70
i	RELAMPING	$96	9	0.7	$67
j	RELAMPING	$96	10	0.68	$65
k	RELAMPING	$96	11	0.65	$62
l	RELAMPING	$96	12	0.62	$60
m	RELAMPING	$96	13	0.6	$58
n	RELAMPING	$96	14	0.58	$56
o	RELAMPING	$96	15	0.56	$54
p	TOTAL	$2,655			$2,145

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) $2,145

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bp1/ECONOMIC LIFE)): 34.4 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $8,177

6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G: 0.34

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): −3.3%

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT POLK REGION NO. 3 PROJECT NO.
PROJECT TITLE: FT POLK AIRFIELD HANGAR LIGHTING EEAP FISCAL YEAR 95
DISCRETE PORTION NAME: LIGHTING RETROFIT BUILDING 4262 SUPPORT AREA LIGHTING
ANALYSIS DATE: 17–Mar–93 ECONOMIC LIFE 15 PREPARER ECD

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$33,732		
B. SIOH	$1,855		
C. DESIGN COST	$2,024		
D. TOTAL COST (1A+1B+1C)	$37,611		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$0	
F. PUBLIC UTILITY COMPANY REBATE		$0	
G. TOTAL INVESTMENT (1D–1E–1F)			$37,611

2. ENERGY SAVINGS (+)/COST(–):

DATE OF NISTIR 85–3273–X USED FOR DISCOUNT FACTORS: OCTOBER 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$0.73	184	$134	11.77	$1,581
B. DIST			$0		$0
C. RESID			$0		$0
D. NG			$0		$0
E. PPG			$0		$0
F. COAL			$0		$0
G. SOLAR			$0		$0
H. GEOTH			$0		$0
I. BIOMA			$0		$0
J. REFUS			$0		$0
K. WIND			$0		$0
L. OTHER			$0		$0
M. DEMAND SAVINGS			$800	11.12	$8,896
N. TOTAL		184	$934		$10,477

3. NON ENERGY SAVINGS (+) OR COST (–):

A. ANNUAL RECURRING (+/–)	$0		
(1) DISCOUNT FACTOR (TABLE A)		–	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$0

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

B. NON RECURRING SAVINGS (+) OR COST(−)

	ITEM	SAVINGS(+) COST(−)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(−)(4)
a	RELAMPING	$408	1	0.96	$392
b	RELAMPING	$408	2	0.92	$375
c	RELAMPING	$408	3	0.89	$363
d	RELAMPING	$408	4	0.85	$347
e	RELAMPING	$408	5	0.82	$335
f	RELAMPING	$66	6	0.79	$52
g	RELAMPING	$66	7	0.76	$50
h	RELAMPING	$66	8	0.73	$48
i	RELAMPING	$66	9	0.7	$46
j	RELAMPING	$66	10	0.68	$45
k	RELAMPING	$66	11	0.65	$43
l	RELAMPING	$66	12	0.62	$41
m	RELAMPING	$66	13	0.6	$40
n	RELAMPING	$66	14	0.58	$38
o	RELAMPING	$66	15	0.56	$37
p	TOTAL	$2,700			$2,252

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) $2,252

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bp1/ECONOMIC LIFE)): 33.8 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $12,729

6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G: 0.34

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): −3.2%

Building 4295

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT POLK REGION NO. 3 PROJECT NO.
PROJECT TITLE: FT POLK AIRFIELD HANGAR LIGHTING EEAP FISCAL YEAR 95
DISCRETE PORTION NAME: LIGHTING RETROFIT BUILDING 4295 HANGAR AND EXTERIOR LIGHTING
ANALYSIS DATE: 17–Mar–93 ECONOMIC LIFE 15 PREPARER ECD

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$24,569		
B. SIOH	$1,351		
C. DESIGN COST	$1,474		
D. TOTAL COST (1A+1B+1C)	$27,394		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$0	
F. PUBLIC UTILITY COMPANY REBATE		$0	
G. TOTAL INVESTMENT (1D–1E–1F)			$27,394

2. ENERGY SAVINGS (+)/COST(–):

DATE OF NISTIR 85–3273–X USED FOR DISCOUNT FACTORS: OCTOBER 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$0.73	276	$201	11.77	$2,371
B. DIST			$0		$0
C. RESID			$0		$0
D. NG			$0		$0
E. PPG			$0		$0
F. COAL			$0		$0
G. SOLAR			$0		$0
H. GEOTH			$0		$0
I. BIOMA			$0		$0
J. REFUS			$0		$0
K. WIND			$0		$0
L. OTHER			$0		$0
M. DEMAND SAVINGS			$230	11.12	$2,558
N. TOTAL		276	$431		$4,929

3. NON ENERGY SAVINGS (+) OR COST (–):

A. ANNUAL RECURRING (+/–)	$0		
(1) DISCOUNT FACTOR (TABLE A)		–	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$0

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

B. NON RECURRING SAVINGS (+) OR COST(−)

	ITEM	SAVINGS(+) COST(−)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(−)(4)
a	RELAMPING	$677	1	0.96	$650
b	RELAMPING	$677	2	0.92	$623
c	RELAMPING	$677	3	0.89	$603
d	RELAMPING	$677	4	0.85	$575
e	RELAMPING	$677	5	0.82	$555
f	RELAMPING	$202	6	0.79	$160
g	RELAMPING	$202	7	0.76	$154
h	RELAMPING	$202	8	0.73	$147
i	RELAMPING	$202	9	0.7	$141
j	RELAMPING	$202	10	0.68	$137
k	RELAMPING	$202	11	0.65	$131
l	RELAMPING	$202	12	0.62	$125
m	RELAMPING	$202	13	0.6	$121
n	RELAMPING	$202	14	0.58	$117
o	RELAMPING	$202	15	0.56	$113
p	TOTAL	$5,405			$4,353

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)	$4,353
4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bp1/ECONOMIC LIFE)):	34.6 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$9,282
6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G:	0.34
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	−3.2%

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT POLK REGION NO. 3 PROJECT NO.
PROJECT TITLE: FT POLK AIRFIELD HANGAR LIGHTING EEAP FISCAL YEAR 95
DISCRETE PORTION NAME: LIGHTING RETROFIT BUILDING 4295 SUPPORT AREA LIGHTING
ANALYSIS DATE: 17-Mar-93 ECONOMIC LIFE 15 PREPARER ECD

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$42,013		
B. SIOH	$2,311		
C. DESIGN COST	$2,521		
D. TOTAL COST (1A+1B+1C)	$46,844		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$0	
F. PUBLIC UTILITY COMPANY REBATE		$0	
G. TOTAL INVESTMENT (1D-1E-1F)			$46,844

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: OCTOBER 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$0.73	191	$139	11.77	$1,641
B. DIST			$0		$0
C. RESID			$0		$0
D. NG			$0		$0
E. PPG			$0		$0
F. COAL			$0		$0
G. SOLAR			$0		$0
H. GEOTH			$0		$0
I. BIOMA			$0		$0
J. REFUS			$0		$0
K. WIND			$0		$0
L. OTHER			$0		$0
M. DEMAND SAVINGS			$810	11.12	$9,007
N. TOTAL		191	$949		$10,648

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	$0		
(1) DISCOUNT FACTOR (TABLE A)		-	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$0

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

B. NON RECURRING SAVINGS (+) OR COST(−)

	ITEM	SAVINGS(+) COST(−)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(−)(4)
a	RELAMPING	$443	1	0.96	$425
b	RELAMPING	$443	2	0.92	$408
c	RELAMPING	$443	3	0.89	$394
d	RELAMPING	$443	4	0.85	$377
e	RELAMPING	$443	5	0.82	$363
f	RELAMPING	($36)	6	0.79	($28)
g	RELAMPING	($36)	7	0.76	($27)
h	RELAMPING	($36)	8	0.73	($26)
i	RELAMPING	($36)	9	0.7	($25)
j	RELAMPING	($36)	10	0.68	($24)
k	RELAMPING	($36)	11	0.65	($23)
l	RELAMPING	($36)	12	0.62	($22)
m	RELAMPING	($36)	13	0.6	($22)
n	RELAMPING	($36)	14	0.58	($21)
o	RELAMPING	($36)	15	0.56	($20)
p	TOTAL	$1,855			$1,727

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) — $1,727

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bp1/ECONOMIC LIFE)): — 43.7 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): — $12,375

6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G: — 0.26

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): — −4.8%

Building 4297

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT POLK REGION NO. 3 PROJECT NO.
PROJECT TITLE: FT POLK AIRFIELD HANGAR LIGHTING EEAP FISCAL YEAR 95
DISCRETE PORTION NAME: LIGHTING RETROFIT BUILDING 4297 HANGAR AND EXTERIOR LIGHTING
ANALYSIS DATE: 17-Mar-93 ECONOMIC LIFE 15 PREPARER ECD

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$39,934		
B. SIOH	$2,196		
C. DESIGN COST	$2,396		
D. TOTAL COST (1A+1B+1C)	$44,526		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$0	
F. PUBLIC UTILITY COMPANY REBATE		$0	
G. TOTAL INVESTMENT (1D-1E-1F)			$44,526

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: OCTOBER 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$0.73	72	$53	11.77	$619
B. DIST			$0		$0
C. RESID			$0		$0
D. NG			$0		$0
E. PPG			$0		$0
F. COAL			$0		$0
G. SOLAR			$0		$0
H. GEOTH			$0		$0
I. BIOMA			$0		$0
J. REFUS			$0		$0
K. WIND			$0		$0
L. OTHER			$0		$0
M. DEMAND SAVINGS			($870)	11.12	($9,674)
N. TOTAL		72	($817)		($9,056)

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	$0		
(1) DISCOUNT FACTOR (TABLE A)		-	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$0

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

B. NON RECURRING SAVINGS (+) OR COST(−)

	ITEM	SAVINGS(+) COST(−)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV–INGS(+)COST(−)(4)
a	RELAMPING	$476	1	0.96	$457
b	RELAMPING	$476	2	0.92	$438
c	RELAMPING	$476	3	0.89	$424
d	RELAMPING	$476	4	0.85	$405
e	RELAMPING	$476	5	0.82	$390
f	RELAMPING	($115)	6	0.79	($91)
g	RELAMPING	($115)	7	0.76	($87)
h	RELAMPING	($115)	8	0.73	($84)
i	RELAMPING	($115)	9	0.7	($81)
j	RELAMPING	($115)	10	0.68	($78)
k	RELAMPING	($115)	11	0.65	($75)
l	RELAMPING	($115)	12	0.62	($71)
m	RELAMPING	($115)	13	0.6	($69)
n	RELAMPING	($115)	14	0.58	($67)
o	RELAMPING	($115)	15	0.56	($64)
p	TOTAL	$1,230			$1,346

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) $1,346

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bp1/ECONOMIC LIFE)): −60.5 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): ($7,709)

6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G: −0.17

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): ERR

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT POLK REGION NO. 3 PROJECT NO.
PROJECT TITLE: FT POLK AIRFIELD HANGAR LIGHTING EEAP FISCAL YEAR 95
DISCRETE PORTION NAME: LIGHTING RETROFIT BUILDING 4297 SUPPORT AREA LIGHTING
ANALYSIS DATE: 17-Mar-93 ECONOMIC LIFE 15 PREPARER ECD

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$21,310		
B. SIOH	$1,172		
C. DESIGN COST	$1,279		
D. TOTAL COST (1A+1B+1C)	$23,761		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$0	
F. PUBLIC UTILITY COMPANY REBATE		$0	
G. TOTAL INVESTMENT (1D-1E-1F)			$23,761

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: OCTOBER 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$0.73	51	$37	11.77	$438
B. DIST			$0		$0
C. RESID			$0		$0
D. NG			$0		$0
E. PPG			$0		$0
F. COAL			$0		$0
G. SOLAR			$0		$0
H. GEOTH			$0		$0
I. BIOMA			$0		$0
J. REFUS			$0		$0
K. WIND			$0		$0
L. OTHER			$0		$0
M. DEMAND SAVINGS			$210	11.12	$2,335
N. TOTAL		51	$247		$2,773

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	$0		
(1) DISCOUNT FACTOR (TABLE A)		-	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$0

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

B. NON RECURRING SAVINGS (+) OR COST(−)

	ITEM	SAVINGS(+) COST(−)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV−INGS(+)COST(−)(4)
a	RELAMPING	$328	1	0.96	$315
b	RELAMPING	$328	2	0.92	$302
c	RELAMPING	$328	3	0.89	$292
d	RELAMPING	$328	4	0.85	$279
e	RELAMPING	$328	5	0.82	$269
f	RELAMPING	($30)	6	0.79	($24)
g	RELAMPING	($30)	7	0.76	($23)
h	RELAMPING	($30)	8	0.73	($22)
i	RELAMPING	($30)	9	0.7	($21)
j	RELAMPING	($30)	10	0.68	($20)
k	RELAMPING	($30)	11	0.65	($20)
l	RELAMPING	($30)	12	0.62	($19)
m	RELAMPING	($30)	13	0.6	($18)
n	RELAMPING	($30)	14	0.58	($17)
o	RELAMPING	($30)	15	0.56	($17)
p	TOTAL	$1,340			$1,256

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) $1,256

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bp1/ECONOMIC LIFE)): 70.6 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $4,030

6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G: 0.17

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): −7.6%

FY 92

LIMITED
ENERGY
STUDY

FORT POLK, LA

HOSPITAL CHILLERS
FREE COOLING

FORT POLK BASE HOSPITAL

CENTRAL PLANT

FREE-COOLING RETROFIT

Fort Polk, Louisiana

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

March, 1993

Prepared by:

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C. **Energy Conservation Opportunity (ECO) Description**

1. The free-cooling system requires the addition of a water to water heat exchanger and piping. Condenser water will be circulated through the heat exchanger during cooler weather to pre-cool the chilled water, thus reducing chiller electrical energy consumption. The condenser water is cooled naturally as it flows through the cooling tower. Since no chiller electrical energy is consumed during this process the system is referred to as a "free" cooling system.

2. Refer to Figure 1 for the proposed system modifications.

D. **Analysis Of Previous Studies**

A previous study was evaluated in the preparation of this report:

1. Study of Air Conditioning System (sic) at the Fort Polk Hospital, prepared by Guillot-Vogt Associates, Inc.

The study was conducted to determine the adequacy of the existing air conditioning and ventilation systems at the base hospital. The report was obtained in order to develop a load profile for the current operation of the hospital. The information in the report indicated only peak loads. It could not be used to develop an hourly profile so another method was developed.

E. **Methodology**

The Trace Customer Direct Service Network Equipment Economics program was used for this analysis. The program uses built-in schedules to model buildings. These predetermined inputs allow for relative comparisons between alternatives to be made when comprehensive data is not available. This was the case for this study. Detailed load profiles for the hospital were not available and the creation of a detailed model of the existing hospital was determined to be cost prohibitive.

Since a load profile was not available the input data was structured as an "Input Building" rather than "Input Loads." Creating a "building" to try to follow the curve for a profile of a small amount of available data is a multi-step procedure. The procedure used is described in detail below.

Step 1 - Existing Data

Each chiller has an ammeter for each of its three phase legs. Base personnel logged morning and afternoon readings for each working day. The ammeter readings were not logged if the chiller was not running.

The ammeter readings described above were tabulated for each chiller for each month. The daily readings were summed and averaged for each half hour time increment. The average was then converted to a percent of full load based on the chiller nameplate rated load amps (RLA). Chiller No. 1 nameplate read 524 RLA and Chiller No. 2 nameplate read 550 RLA.

The ammeter log worksheets are presented as Appendix A.

Step 2 - Initial Load Profile

An initial Equipment Economics program analysis was performed to create a starting profile. The building square footage, number of stories and building construction shape were input. The glass and wall u-valves were taken from the previous study.

The initial Equipment Economics input has not been included since it was later modified. Refer to Step 4.

Step 3 - Develop Base Load

From the chiller logs and the initial Equipment Economics run, a tabular summary was created. The average RLA from each of the chillers was tabulated by month. The averages were summed for an overall total RLA. This total was then divided by the maximum RLA (524 RLA + 550 RLA = 1074 RLA) to arrive at a percent of full load.

Next the tonnage from the output of the initial Equipment Economics run was tabulated. This data can be found in the "Building Cool-Heat Demand" section of the output. (Refer to Appendix D). To develop the percentage of full load tonnage, the hourly loads were divided by the nameplate tonnage of the chillers:

Chiller No. 1 : 519 tons

Chiller No. 2 : 465 tons

Full Load Tons : 984 tons.

Next the difference between the actual data percentage and the Equipment Economics percentage was calculated. By observing these percentage differences it is apparent that a "base load" exists. The differences were averaged and tabulated in the AVG column. This average was multiplied by the full load tons (984 tons) to calculate the base load.

Finally, the adjusted percentage was calculated by summing the base load tonnage and the Equipment Economics output tonnage, then dividing the total by the full load tonnage.

The actual and computer data summary as well as graphic summaries are presented as Appendix B.

Step 4 - Base Load Profile

The base load base utility schedule was input as a percentage of maximum base load. The maximum base load was 573 tons and occurred in April. All other months were input as a percentage of 573 tons. Consequently, April shows a scheduled percentage of 100%.

Since actual data for the months of August through December was not available, the assumption was made that the weather data for July and August, May and September, April and October, March and November and January and December was similar.

This schedule was input as a base utility of 573 tons with the schedule described above.

Since a base utility affects only the energy consumption of the equipment defined, the profile for the initial analysis does not reflect a change. The energy consumption of the equipment defined however, does increase.

The final Equipment Economics run input data and support schedules are presented as Appendix C.

After the "existing" load input was developed, a second alternative was added to simulate the free-cooling system. The relative difference between the developed baseline model and the alternative model forms the basis of this analysis.

The final Equipment Economics run output data is presented as Appendix D.

When the energy consumption analysis was complete, probable cost estimates for construction, expected maintenance, replacement and salvage values were developed. These estimated costs, the calculated energy savings and energy prices were input into the LCCID program using the Energy Conservation Investment Program (ECIP) option.

The LCCID ECIP output form is included in Appendix G.

F. Life Cycle Cost Calculations

The Life Cycle economic feasibility of the existing system with the free cooling option was calculated utilizing the Life Cycle Cost In Design (LCCID) program. Data for the LCCID Feasibility study are as follows:

1. Construction Cost Estimate

The probable addition construction cost estimate for the proposed ECO is as follows:

ECO	Additional Investment
Free Cooling	$ 33,890

Refer to Appendix E for the probable cost estimate.

2. Maintenance Cost Estimate

The addition maintenance costs for the proposed ECO was developed based on data from AD-A236-425 and is as follows:

ECO	Annual Maintenance Cost
Free Cooling	$ 75.24/yr

Refer to Appendix E for Maintenance Cost Calculations.

3. Replacement Cost Estimate

The heat exchanger is expected to have a life of 24 years based on the typical life expectancy listed in the 1991 ASHRAE Applications Handbook. The 1991 ASHRAE Applications Handbook lists valve actuators as having a life expectancy of 20 years. Since the study life is 20 years, it is not expected that any major equipment will require replacement. The replacement cost for this study was assumed to be zero ($0.00).

4. Final Salvage Value

The Final Salvage value for all systems is assumed to be zero dollars ($0.00).

5. Utility Rates

Utility Type	$/KWH	$/MBTU
Electricity Usage	0.0558	16.35

The site utility costs were furnished by base personnel. Refer to Appendix F for energy cost data.

G. Conclusions

The results of this study indicate that a free cooling system for the base hospital central plant at Fort Polk cannot be justified. This project does not meet the qualifications for an ECIP project. Total cost are less than $200,000; therefore, this ECO could qualify for a non-ECIP project. Although with an SIR less than 1.0 and the simple payback of greater than 14.0 years, this project will not qualify for a non-ECIP project.

H. Maintenance & Repair

During the site investigation, the chiller central plant appeared to be working sufficiently and maintained properly. Although, it was indicated that the cooling tower is seldom cleaned due to the inability to drain the cooling tower. Adding an accessible drainage system for regular maintenance of the cooling tower is suggested.

I. Future ECO's

1. The existing chillers utilize pneumatic controls with no automation. The control system could be retrofitted to electronic or direct digital control. This retrofit would allow for various application programs (i.e. optimum Start/Stop, Chilled Water Reset, etc.) which would result in energy savings.

2. These chillers are piped in series with a constant flow chilled water circulation system. This system can be retrofitted to a piping system with primary and secondary chilled water distribution loops. The primary loop would maintain a constant flow through the chillers. The secondary loop would take water from the primary loop and serve the hospital. The secondary pumping system would be variable flow to met the hospital demand; therefore, realizing energy savings. This type of system will provide more efficient operation and greater flexibility than the existing system. For example, a different type of chiller (i.e., gas absorption, steam absorption, etc.) could easily be added to the primary loop system. These types of chiller can be used to reduce electrical demand costs. In addition, with this variable flow secondary loop serving the Hospital, all 3-way valves would be replaced with a 2-way valves to equalize flow in partial load operation.

3. The median life per 1991 ASHRAE Applications Handbook for a water cooled chiller is 23 years. The efficiency of the existing chillers is approximately .79KW/Ton. By replacing these chillers with new .65 KW/Ton high efficiency chillers, an energy savings can be realized. With the high cost of new chillers, this ECO probably would not meet the simple payback guidelines for an ECIP project. In addition, with the rising cost of refrigerant, this ECO may become more feasible, especially if the new chillers utilize an "environmentally safe" refrigerant. (i.e. R123)

J. **Criteria**

1. OCE-AEI
   Design Criteria
   December 9, 1991

2. Memorandum CEHSC-FU-M
   Energy Conservation Investment Program (ECIP)
   Guidance
   November 4, 1992

3. ASHRAE
   Applications Handbook
   1991

4. TM 5-802-1
   Economic Studies for Military construction Design Applications
   December 1986

5. AD-A236-425
   Building Component Maintenance and Repair Data Base: Heating Ventilating and Air Conditioning (HVAC) Systems
   March 1991

6. TM5-785
   Engineering Weather Data
   July 1, 1978

APPENDIX G - Life Cycle Cost Calculations

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT POLK REGION NO. 3 PROJECT NO.
PROJECT TITLE: BASE HOSPITAL CENTRAL PLAN FISCAL YEAR 95
DISCRETE PORTION NAME: FREE COOLING SYSTEM ANALYSIS
ANALYSIS DATE: 09-Mar-93 ECONOMIC LIFE 20 PREPARER D. YOUNG

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$33,890		
B. SIOH	$1,864		
C. DESIGN COST	$2,033		
D. TOTAL COST (1A+1B+1C)	$37,787		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$0	
F. PUBLIC UTILITY COMPANY REBATE		$0	
G. TOTAL INVESTMENT (1D-1E-1F)			$37,787

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$16.35	160	$2,616	14.65	$38,324
B. DIST			$0	17.70	$0
C. RESID			$0	20.99	$0
D. NG			$0	20.60	$0
E. PPG			$0	13.59	$0
F. COAL			$0	16.32	$0
G. SOLAR			$0	13.59	$0
H. GEOTH			$0	13.59	$0
I. BIOMA			$0	13.59	$0
J. REFUS			$0	13.59	$0
K. WIND			$0	13.59	$0
L. OTHER			$0	13.59	$0
M. DEMAND SAVINGS			$0	13.59	$0
N. TOTAL		160	$2,616		$38,324

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	($75)		
(1) DISCOUNT FACTOR (TABLE A)		13.59	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			($1,023)

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

B. NON RECURRING SAVINGS (+) OR COST(−)

	ITEM	SAVINGS(+) COST(−)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV−INGS(+)COST(−)(4)
a.					$0
b.					$0
c.					$0
o.					$0
p.	TOTAL	$0			$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) ($1,023)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bp1/ECONOMIC LIFE)): 14.4 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $37,302

6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G: 0.99

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 3.9%